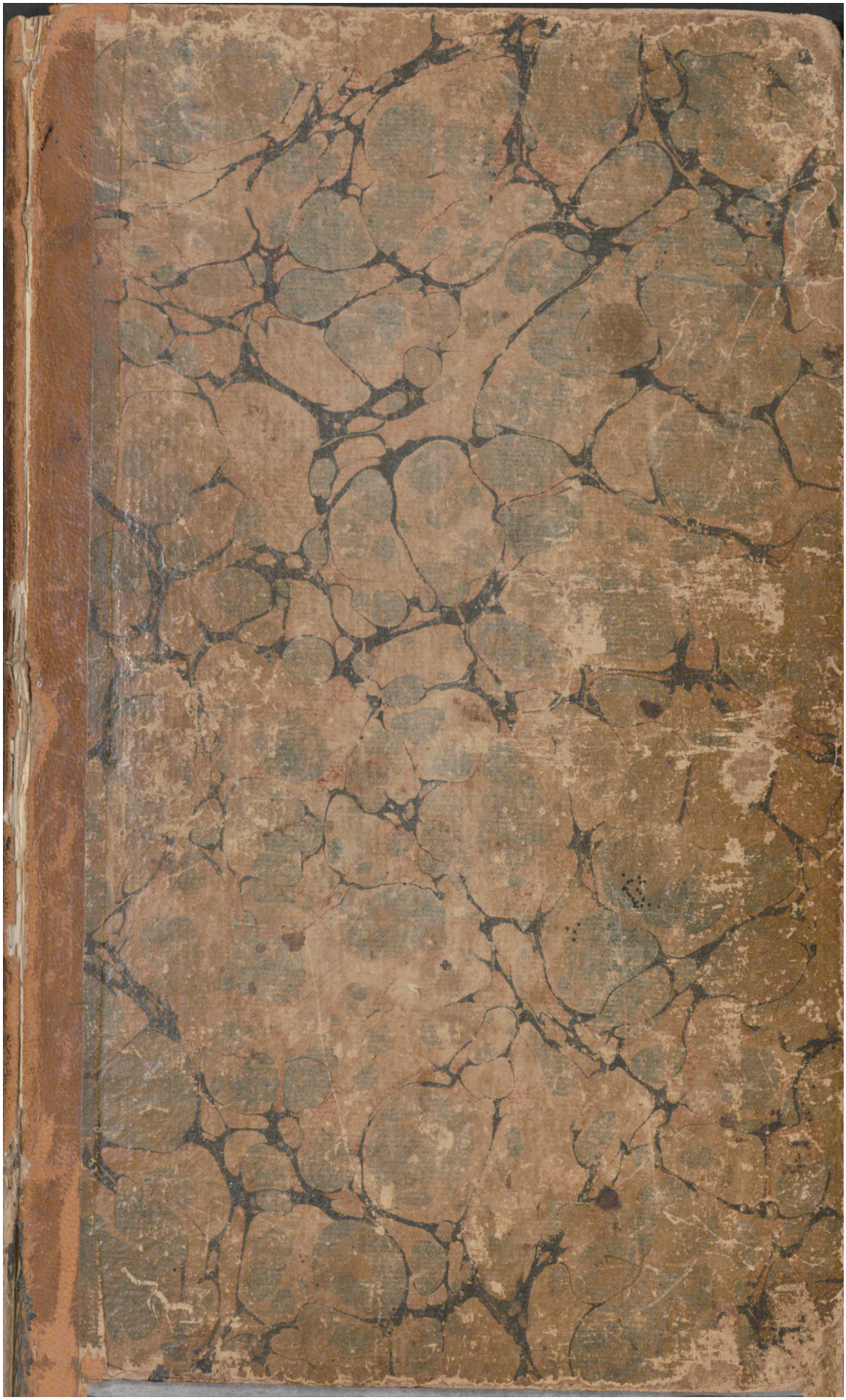
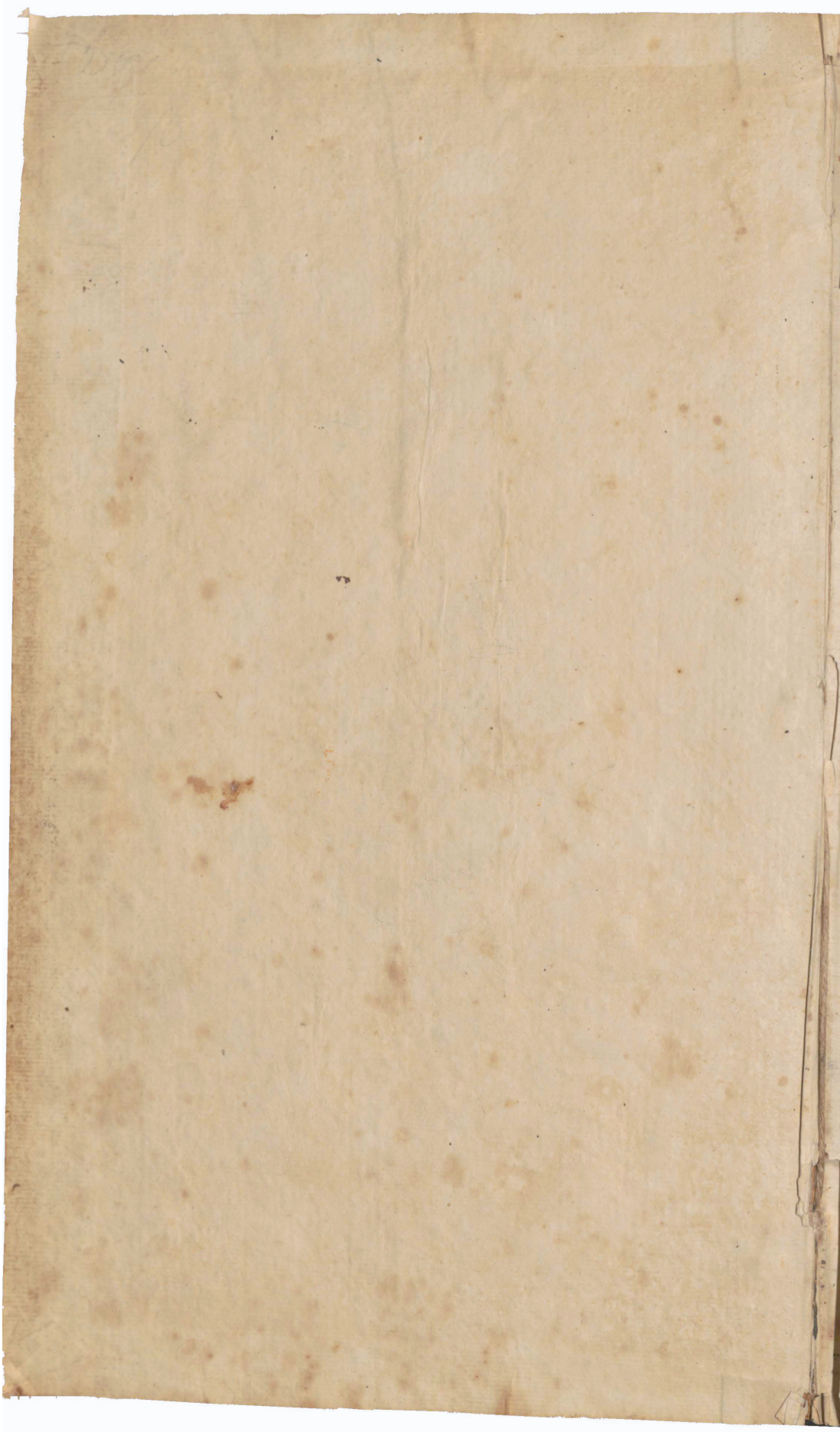
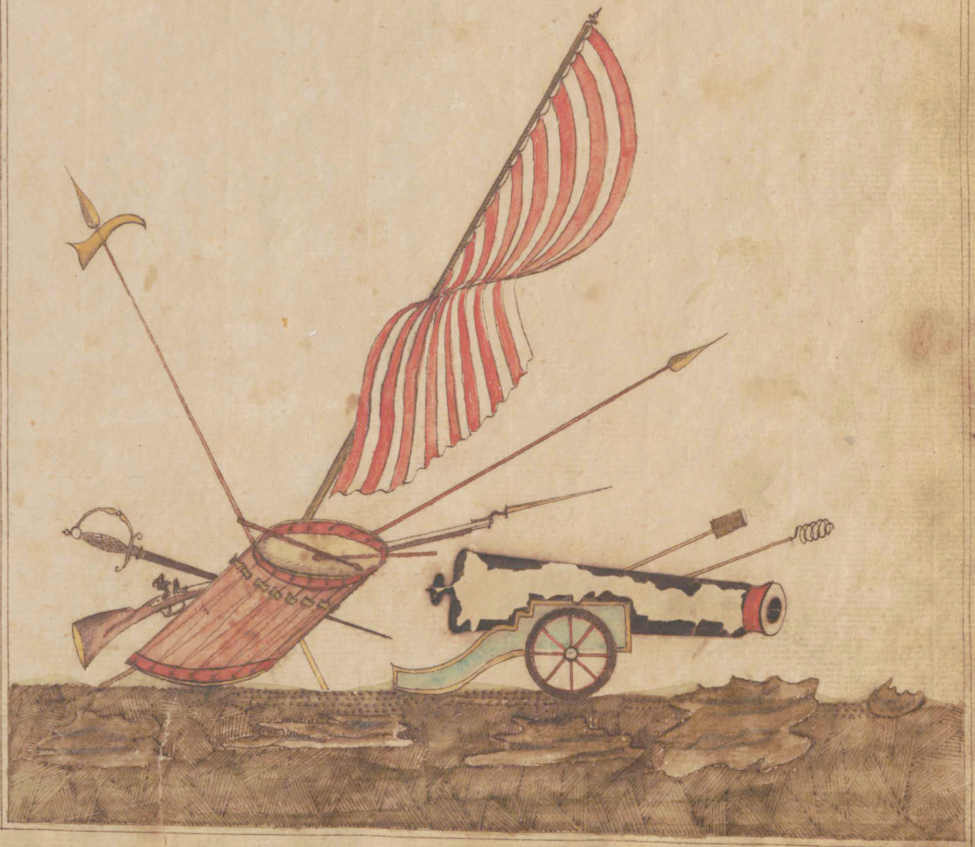


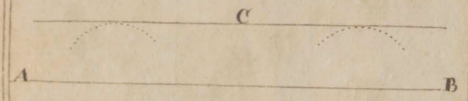


Francis Kittal's Navigation book

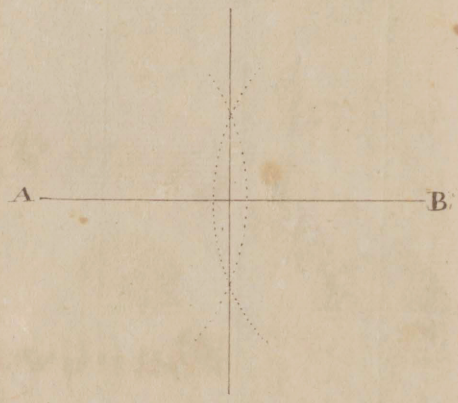


Geometrical Problems

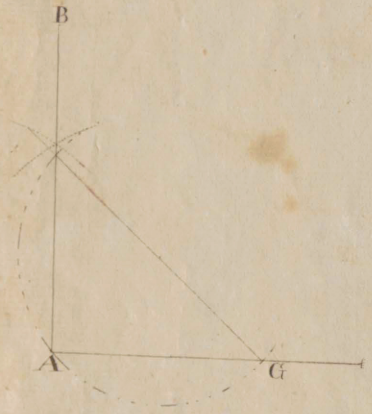
To draw a line parallel to a given Line AB at any given distance as C



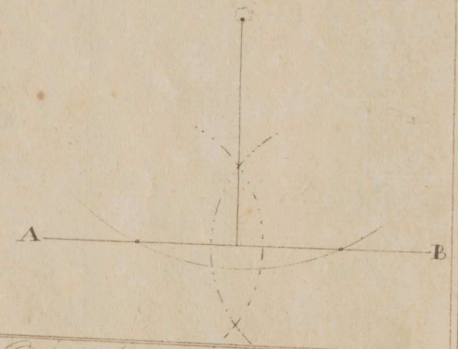
To divide a line in to two Equal parts as A B



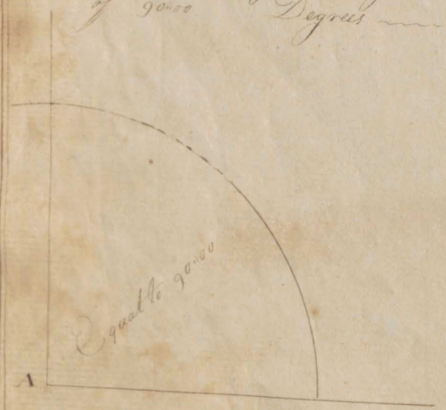
At the End of a line to raise a perpendiculer as A B



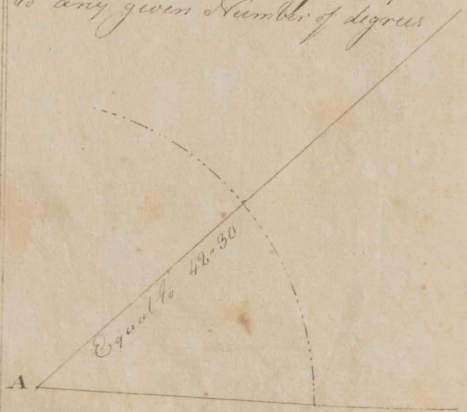
From a point Over a Line to let fall a perpendicular as A B



To Make a right Angle of 90-00 Degrees

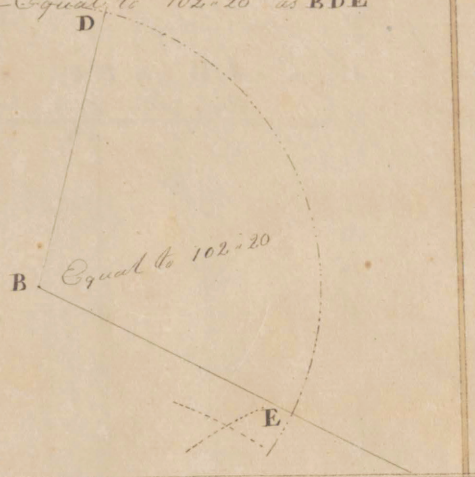


To Make an Angle Equal to any given Number of degrees

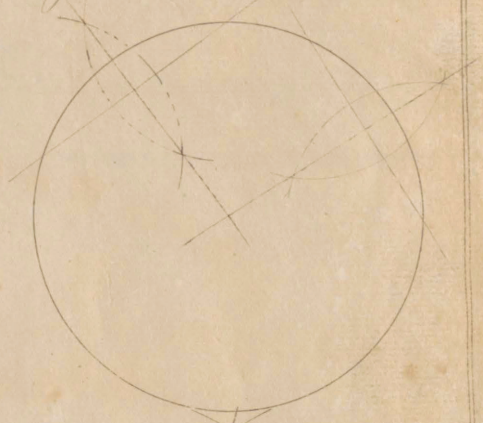


GEOMETRICAL PROBLEMS.

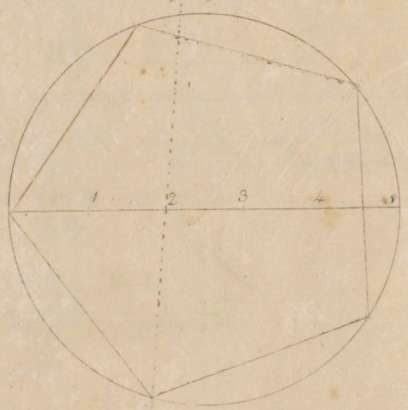
To Make an Obtuse Angle Equal to 102-20 as BDE



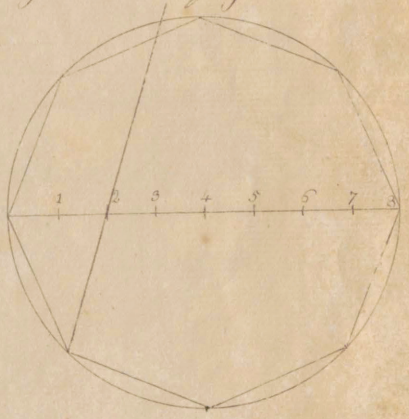
To find the Center of a Given Circle



In a Circle to Make a Pentagon or five sided figure



In a Circle to make an Octagon of Eight sided figure



To find the Center of a Circle that shall pass thro 3 given points

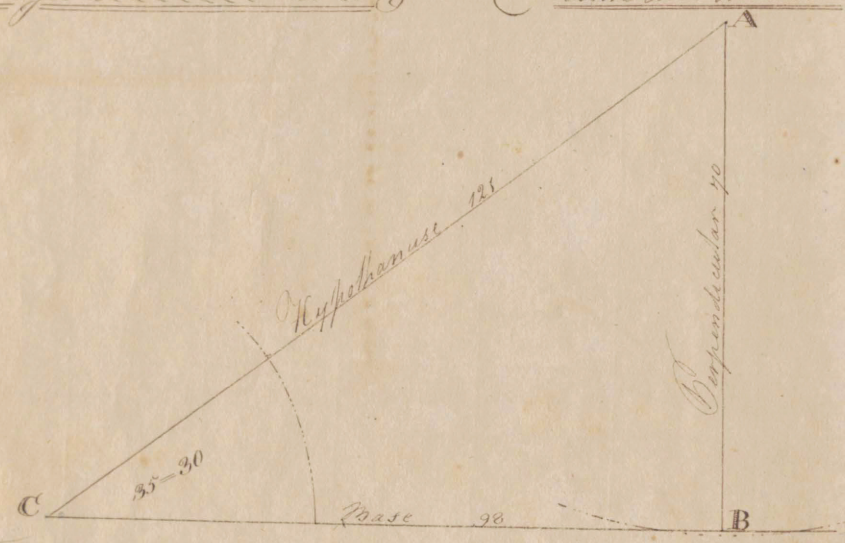
In a Triangle to Make the greatest Circle

Geometrical Problems

The Angels and Hypothanuse of a rite Angle triangle given to find Either of the Legs

Given AC ——— 121 Leagues
the Angle ——— 35°30

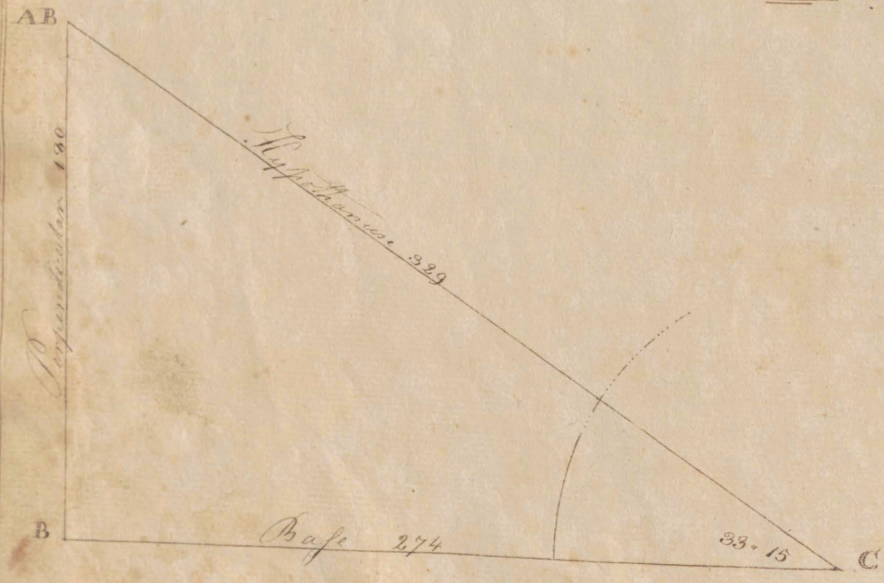
Req^{d} AB & BC



The Angles and one Leg given of a right Angle triangle to find the Hypothanuse and Other Leg

Angle ABC 33.15
BC 274

Req^{d} AB & BC

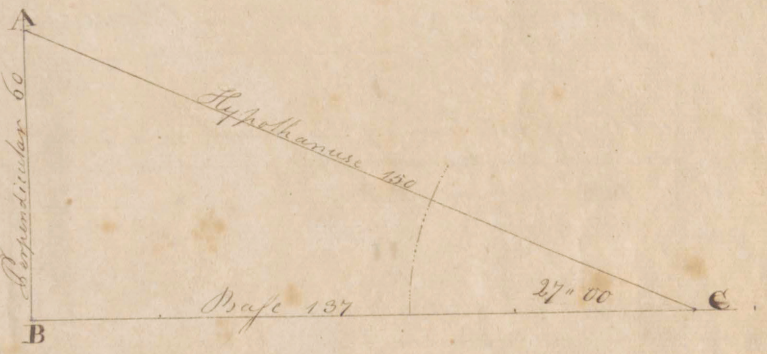


Geometrical Problems

To the hypothanuse and One Leg given to find the Angles and other Leg

The Leg ——— AB ——— 69
Hypothanuse ——— 150

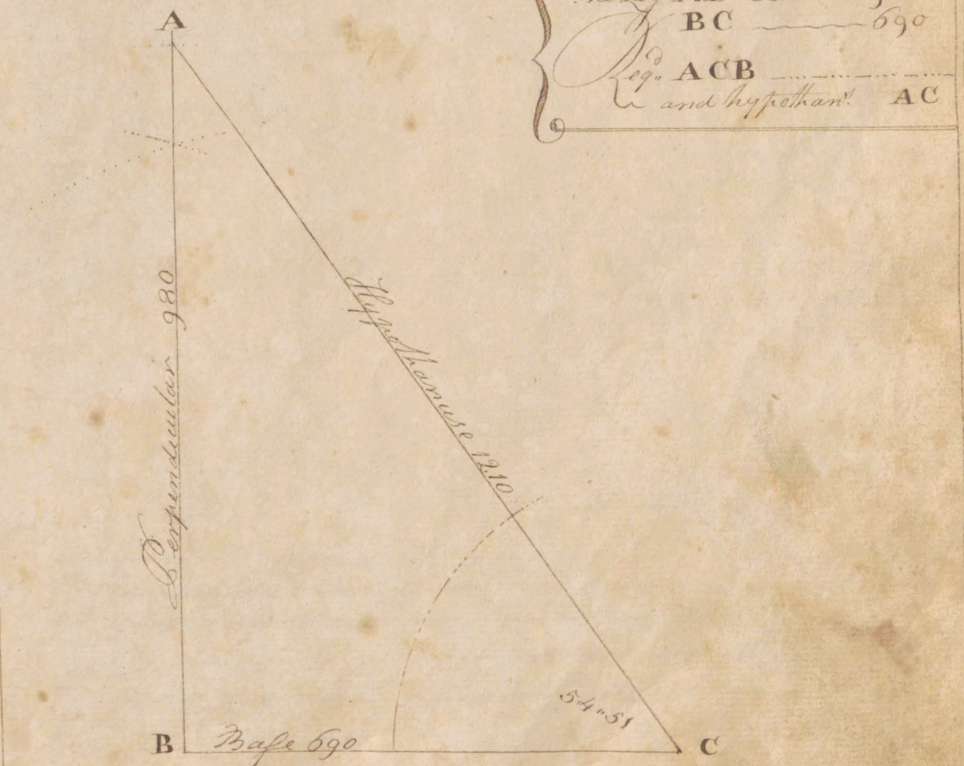
Req^d the Angle ABC & BC



To the Leg^s given to find the Angles and Hypothanuse

The Leg AB ——— 980
BC ——— 690

Leg^s ACB
and hypothan^s AC



Plane Trigonometry or the Doctrine of Plane Trigonometry

Teaches the Mensuration of triangls. by Comparing the sides and Angles together by known Analogies; Whereby three things being given, a fourth may be found on condition that one of them Be a side; in which right Lines are Applied to the Arches of a circle, that the proportion they bear to the sides of a plane triangle may be found

The Right Lines Applied to a Circle are Chords, Sines, Tangents and Secants

I

A Chord or subtence of an Arch, is a right Line that divids a Circle in to two unequal parts, and is a Chord to them both as AS and PS

II

A Right sine of an Arch is a line drawn from one End or termination of an Arch perpendicular to the radius, or it is half the Cord of twice the Arch; so that RS is the sine of the Arch SA and of the arch SD the sum of wich Arches make 180° or a semicircle

III

The Versed sine is that part of the diameter Contained between the right sine and the arch where fore RA is the Versed sine of the arch SA and RD the Versed sine of the Arch SD

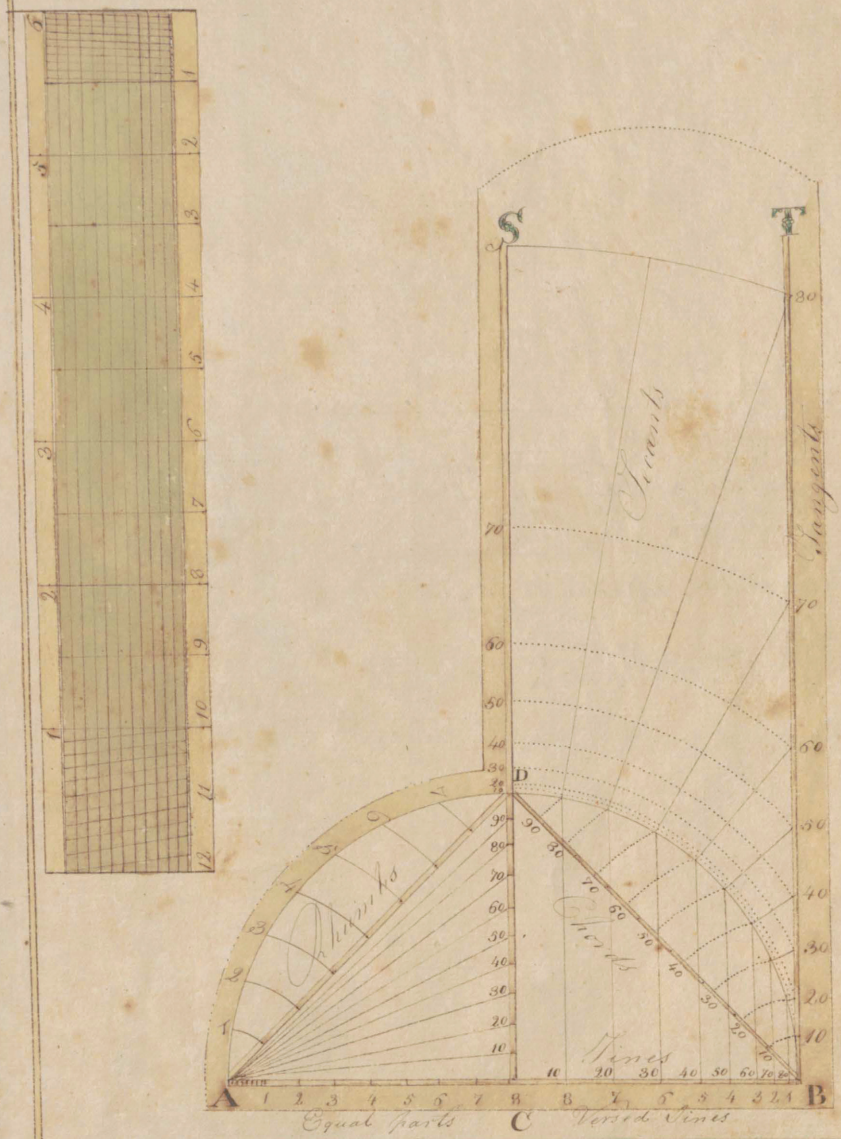
IV

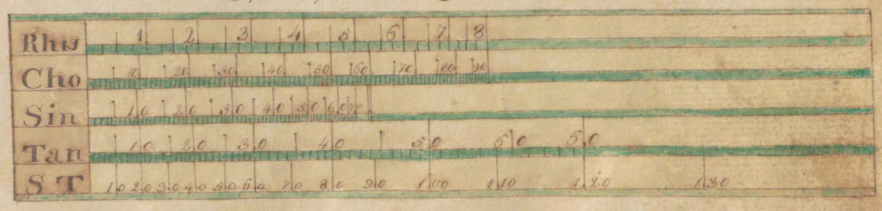
The Tangent of an arch is a right line drawn perpendicularly from one End of the diameter as AT

The secant of an Arch is a right line drawn from the Center through the Circumference by wheich the Tangent is Termenated; wherefore CT is the secant of the Arches SA and SD.

The sine Tangent &c. of the Compliement of any Arch is called the Co. sine; Co Tangent &c. of the Arch. Thus HS is the Co sine and BG the Com. Tangent to the Arch AS

PROJECTION
of The
PLAIN SCALES



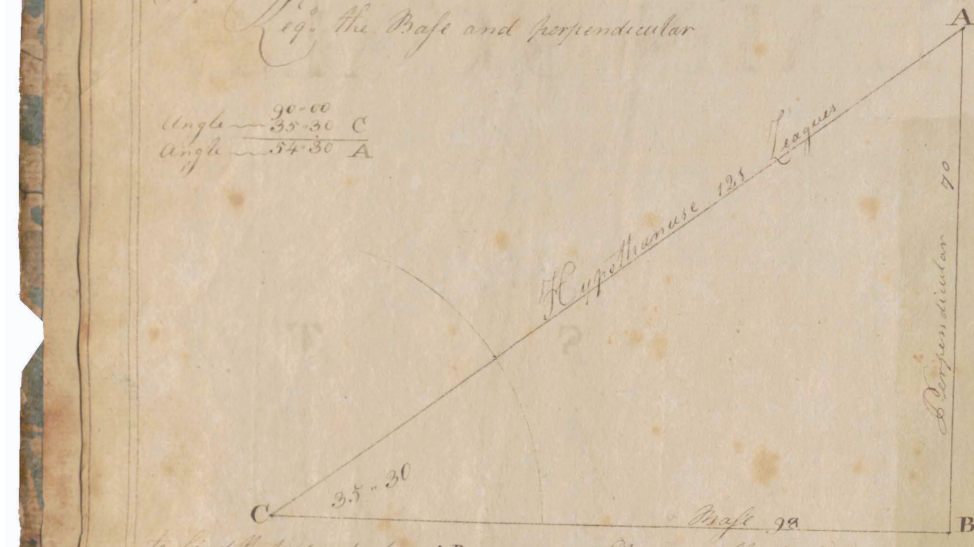


Trigonometry

The Angles and Hypothanuse given to find either of the Legs

Given Hypothanuse 125 Leagues the Angle 35°30'

Req.d the Base and perpendicular



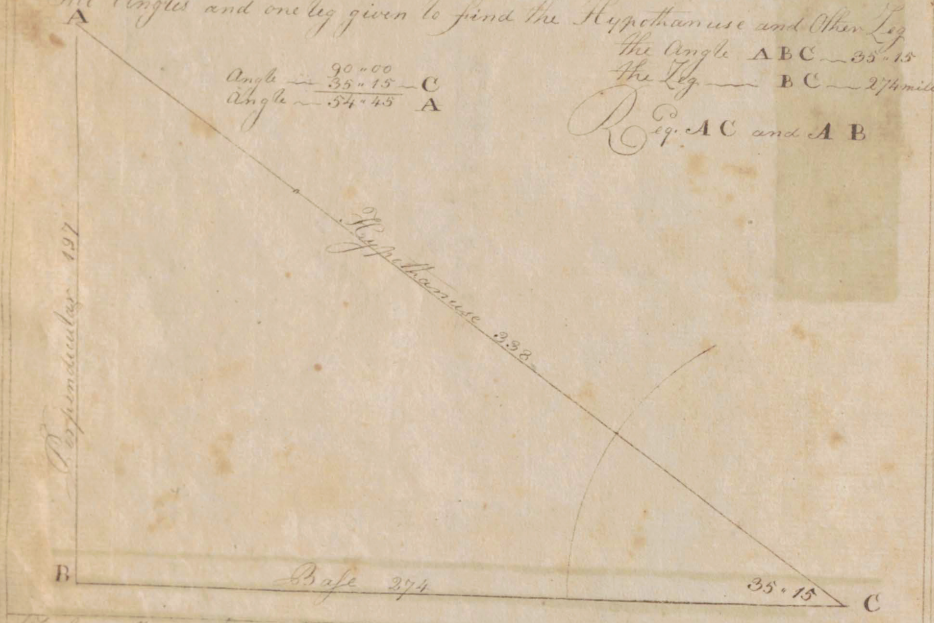
to find the perpendicular AB			*To find the Base* CB		
As radius	90	10·00000	*As Radius*	90	10·00000
is to the Hypoth.s CA	125	2·08278	*Is to the hypothon*	125	2·08278
So is the sine Ang.e C	35°30	9·76395	*So is sine Angle* A 54°30		9·91059
to the perpendicular AB	70	1·84673	*to the Base* BC	98	1·99347

The Angles and one leg given to find the Hypothanuse and Other Leg

the Angle ABC 35°15

the Leg BC 274 miles

Req.d AC *and* AB

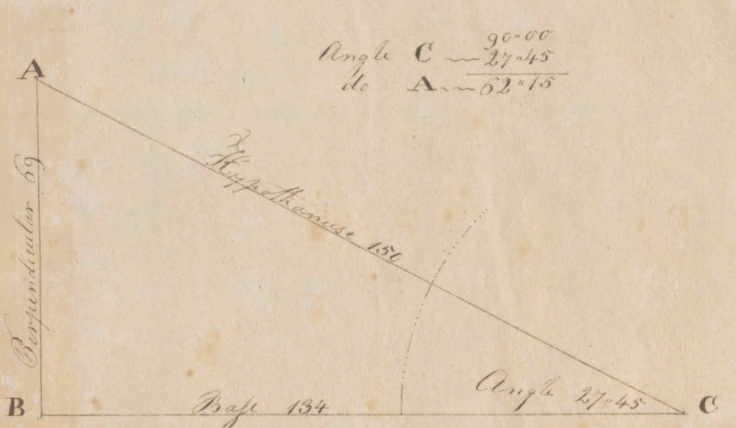


To find the perpen.r AB			*To find the Hypothon.s* AC		
As the sine Angle	54°45	9·91203	*As the sine Angle*	54°45	9·91203
is to the Base BC	274	2·43775	*is to the Base*	274	2·43775
So is the sine Angle	35°15	9·76129	*So is the Radius*	90	10·00000
to the perpen.r	193	2·28703	*to the hypothonuse*	335	2·52572

Trigonometry

The Hypothanuse and One Leg Given to find the Angles and Other Leg

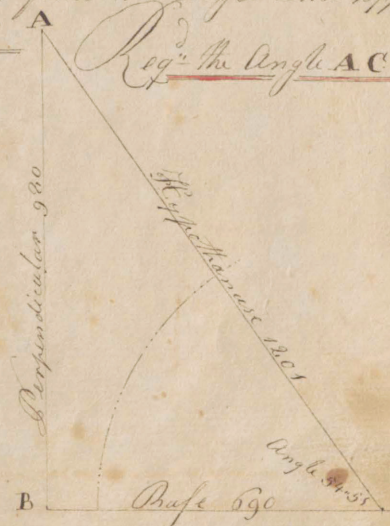
Required the leg AB ——— 69
Hypothen.se AC ——— 150
& the Angle BCA & BC ———



To find Angle C			To find the Base BC		
As the hypothanuse —	150	2-16709	As Radius ———	90	10-00000
To to Radius ———	90	10-00000	To to the hypoth.se —	150	2-17609
so the perpendicular	69	1-83885	so is the sine Angle A	62-15	9-94694
to Sine Angle ———	27-23	9-66276	To the Base ———	133	2-12303

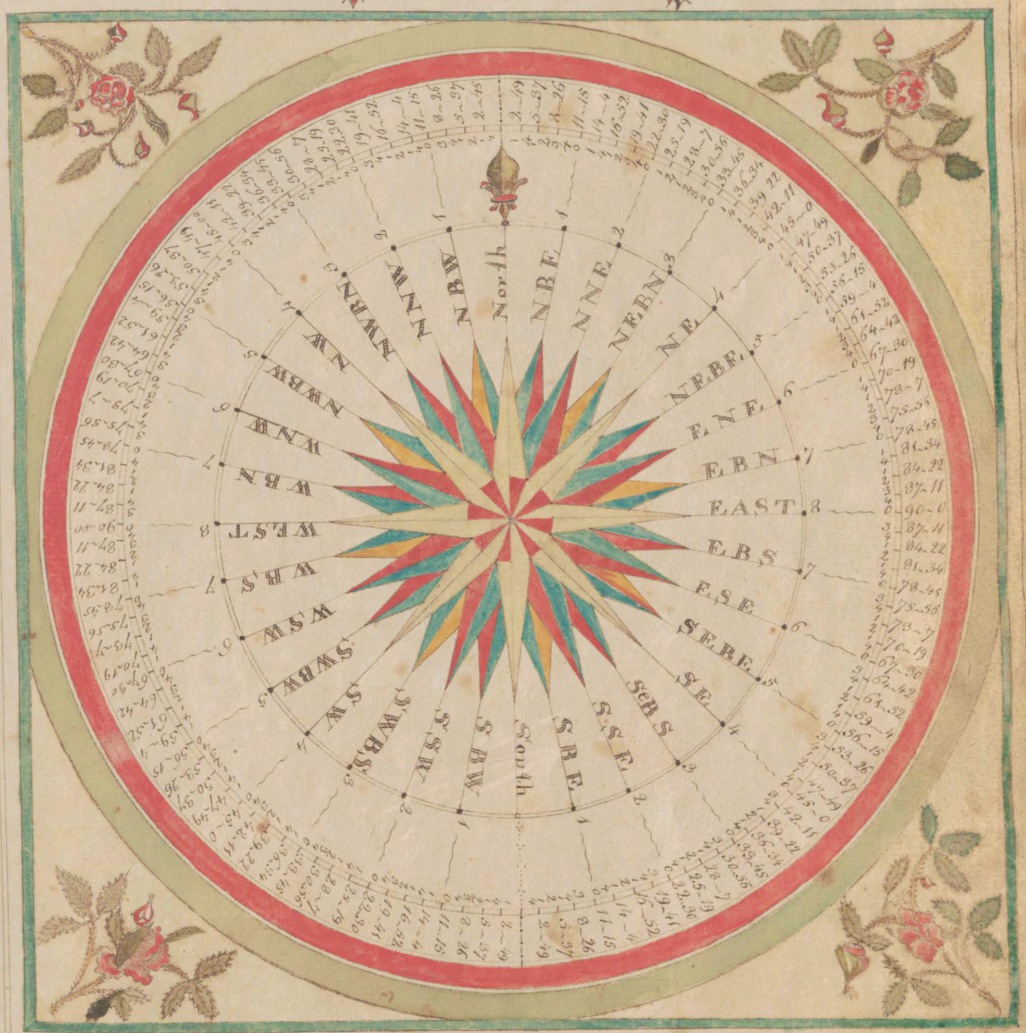
The Legs given to find the Angle and hypothanuse — the Leg AB 980. BC 690

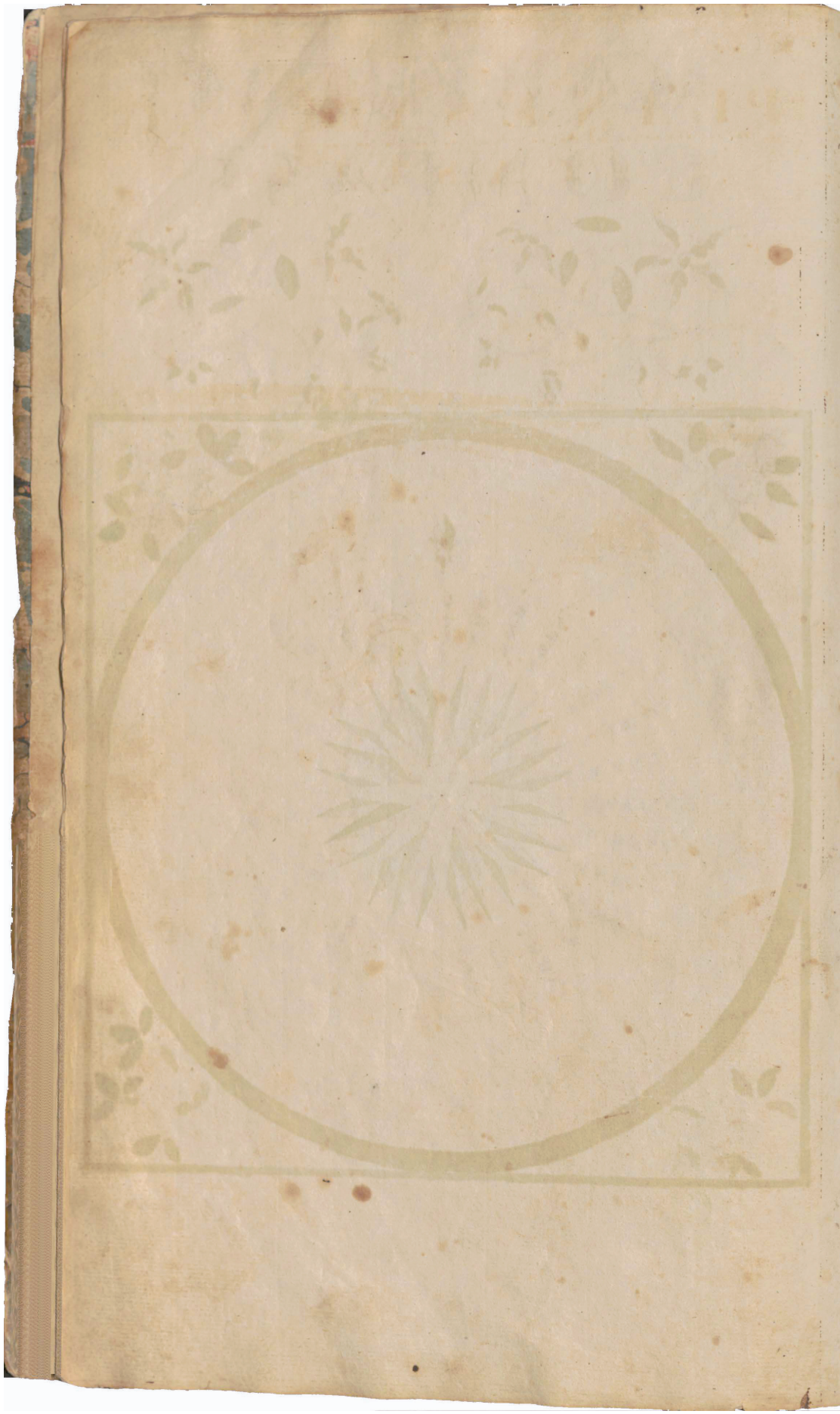
Required the Angle ACB & hypothan.se AC —



To find Angle C			To find the Hypothanuse AC		
As the Base —	690	2-83885	As Radius ———	90	10-00000
is to the Radius —	90	10-00000	is to the perpendicular	690	2-83885
so is the perpendicular	980	2-99123	So is the Secon.t Angle 54-51		10-23979
To the Tangent Angle C	54-51	10-15238	To the hypothanuse —	1198	3-07664

MARINERS COMPASS



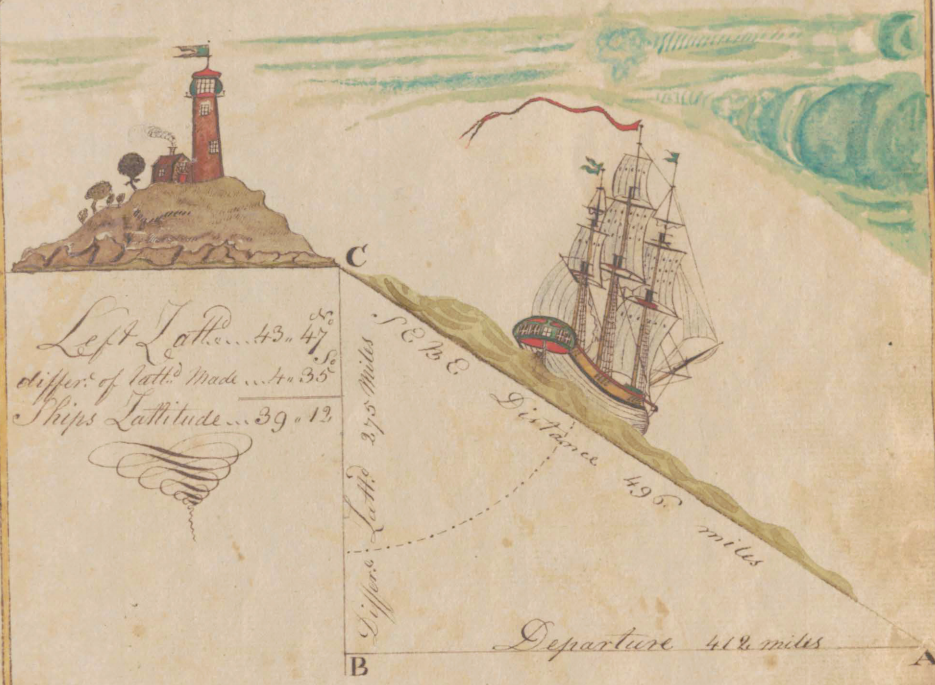


PLANE SAILING.

CASE I.

Course and distance sailed given, to find the difference of Lattitude and the departure from the meridian.

Suppose a Ship from the Island of Seguin in Lattitude of 43-47 sails S E by E 496 miles: Required the Latt.e come to and departure from the meridian



To Find the Departure	B	A
as Radius	90	10 ° 00000
Is to the distance	496	2 ° 69548
So is the sine of the Cours 5pts	56 ° 15	9 ° 91985
to the Departure	412	2 ° 61533

To Find the Differance of Latte	C	B
as Radius	90	10 ° 00000
is to the distance	496	2 ° 69548
So is Co sine of the Course 5pts	56 ° 15	9 ° 74474
to the diff.e of Latt.e	275	2 ° 44022

PLANE SAILING.

CASE. II

Course and difference of Lattitude given. To find the distance run and departure from the Meridian.

If a Ship sails S.S.W.½W. from 1°45 North Lattitude and then by Observation is in 2°30 South Latt^e. what is her distance and departure.

Lattitude left	1°45 N^o
Latt^e Come in to	2°30 S^o
Diff^e of lattitude	4°35

To find the departure	C.	D.
As the Co sine of the Course	56°15	9°74474
Is to the diff^e of Latt^e	275	2°43933
So the Sine of the Course	55°15	9°91985
To the departure	411	2°61444

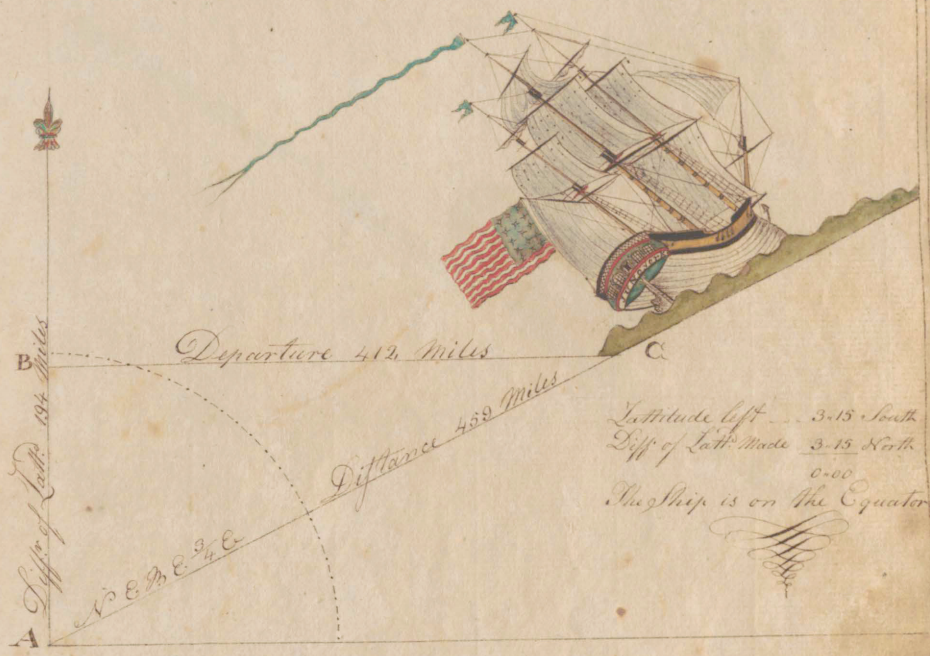
To find the distance	A	C
As the Co sine of the Course	56°15	9°74474
Is to the diff^e of Latt^e	275	2°43933
So is Radius	90	10°00000
To the distance	49.5	1°69459

PLANE SAILING.

CASE III.

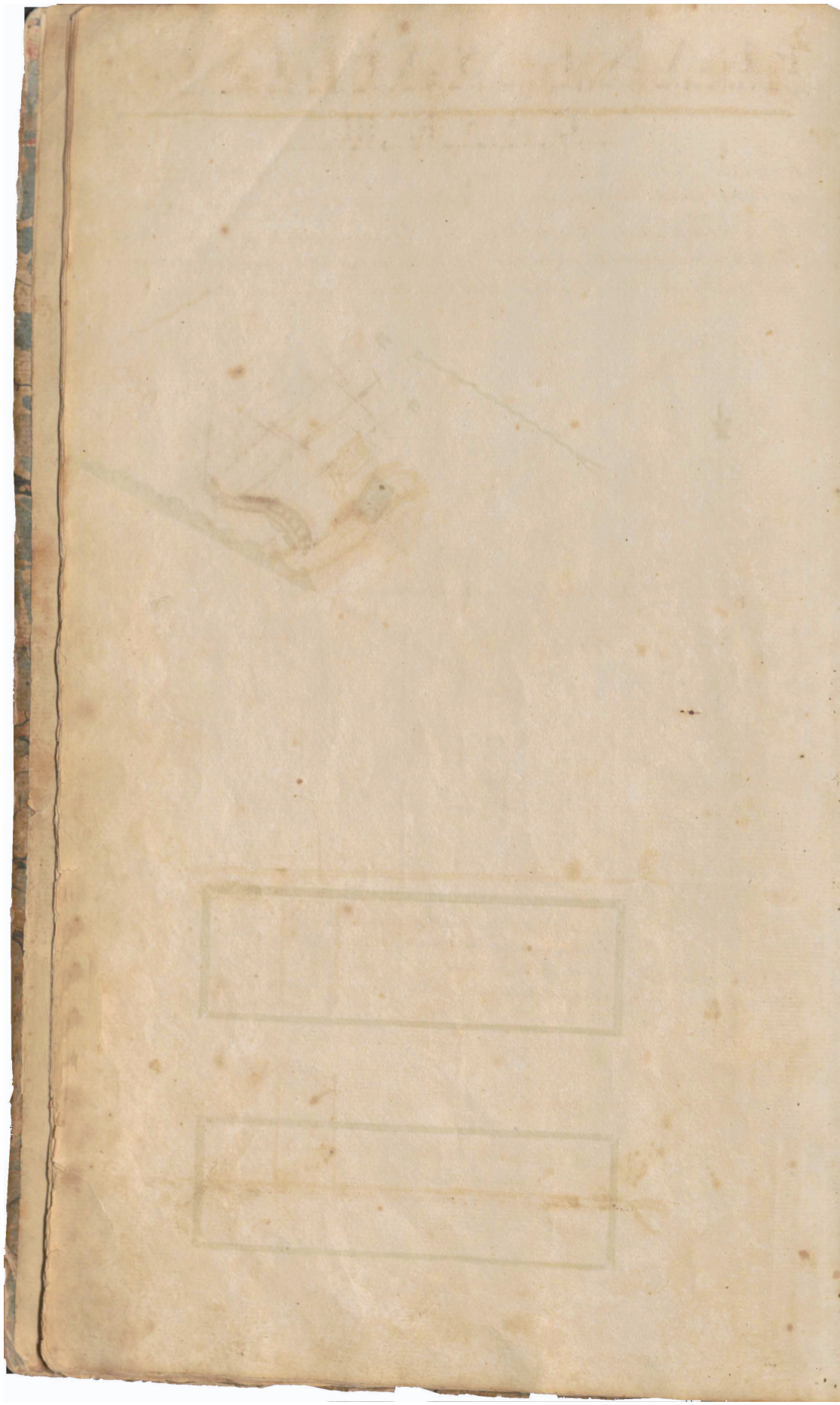
Course and departure from the Meridian given, to find the distance and difference of Latitude

If a Ship sails N.E. by E. 3/4 E. from a port in 3.15 South Latitude Until she departs from her first Meridian 412 miles I demand her distance and what Latt. she is in



To find the diff of Latt.	A B	
As the sine of the Course 3p 3/4 . . .	64.42	9.95675
Is to the departure	412	2.61490
so is the Co sine of the Cours . .	64.42	9.63099
To the diff of Latt	194	2.28973

To Find the distance	A C	
As the sine of the Course . . .	64.42	9.95616
Is to the departure	412	2.61490
so is Radius	90	10.00000
to the distance	459	2.65874



PLANE SAILING.

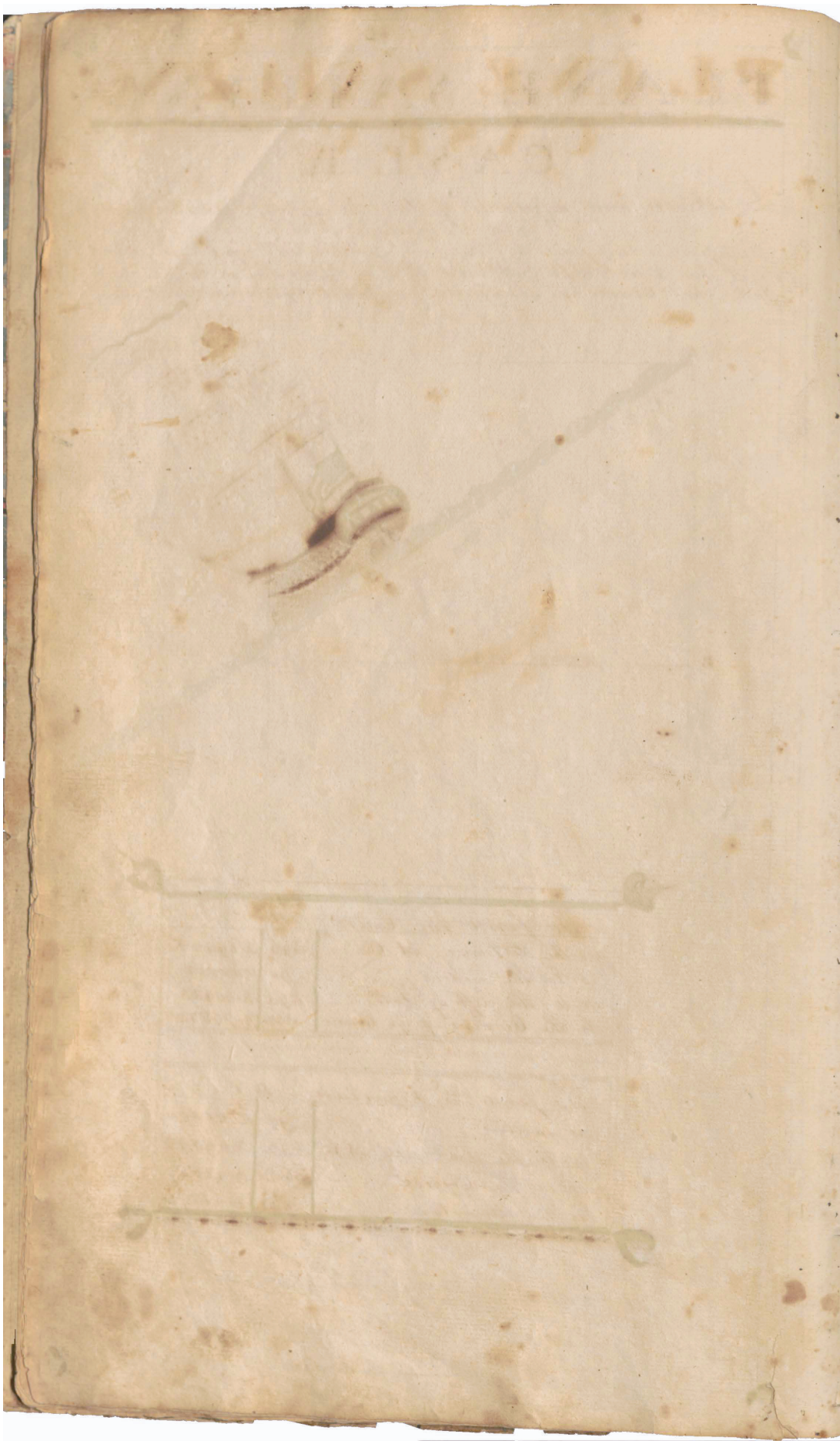
CASE IV.

Distance and differance of Lattitude given. to find the Course and Departure

Suppose a Ship sails 496 Miles between the South and East from a Port In 2.48 South Latt. and then by Observation is In 7.23 South Latt. what Course has she Steered and Inwhat departure has she Made

To find the Course		
as the distance A C	496	2.69548
is to the radius	90	10.00000
so is the diff. of Latt.	275	2.43933
to the Co. sine of ye Course	36.20	9.74385

To find the Departure	B C	
as radius	90	10.00000
is to the distance A C	496	2.69548
so is the Course	36.20	9.92027
to the departure	413	2.61575

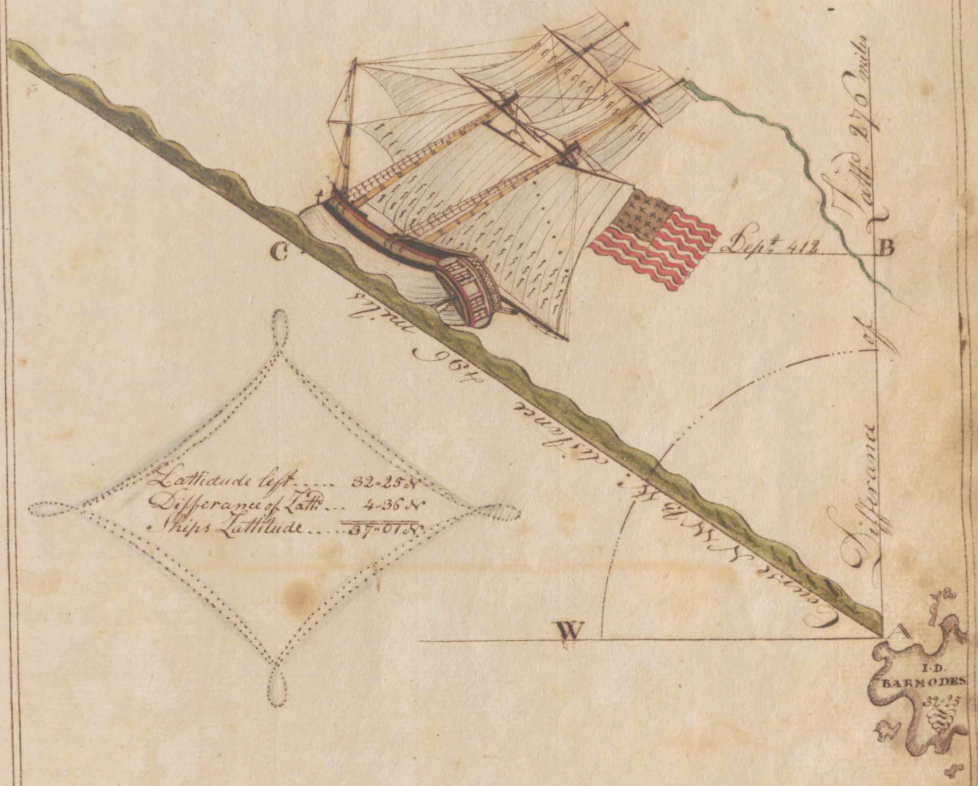


PLANE SAILING.

CASE V.

Distance and departure given To find the course and difference of Lattitude

Admit a Thief sails 496 Miles between the North and West from the Island of Bermudas in Lattitude of 32.25 No: until her departure is 412 Miles: what Course has she steered and what Lattitude is she in



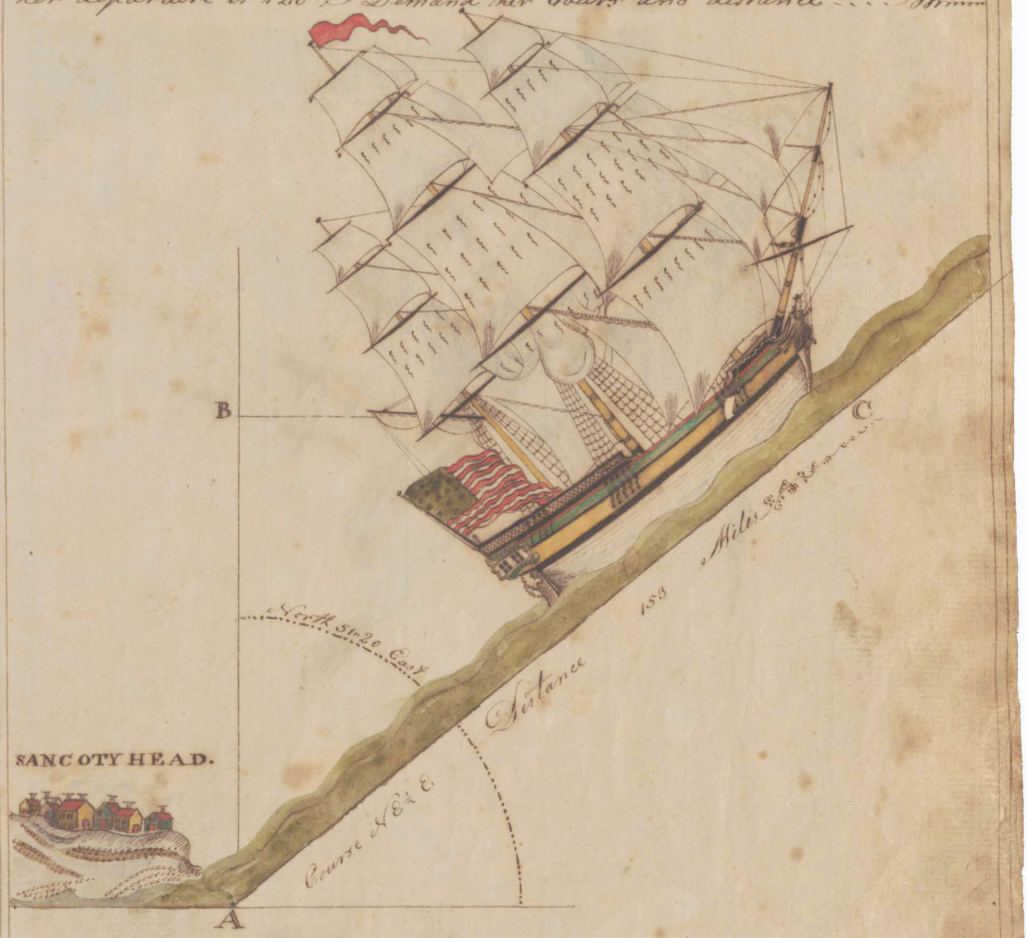
To find the Course		A C		To find Dif: Latt:		A B	
As the distance 496	496	2.69548		As radious	90	10.00000	
Is to Radious	90	10.00000		Is to the distance	496	2.69548	
So is the departure	412	2.69540		So is the Comf Co	56.10	9.74568	
To ye Sine of ye Course	56.	9.91942		To ye dif: of Latt:	275	2.44116	

PLANE SAILING

CASE VI

Difference of Lattitude and departure given to find the Course and Distance

A Ship sails from the Island of Nantucket on some Cours between the North and East Until her difference of Latt.e is 96 miles and her departure is 120 I Demand her Cours and distance .... Mmm

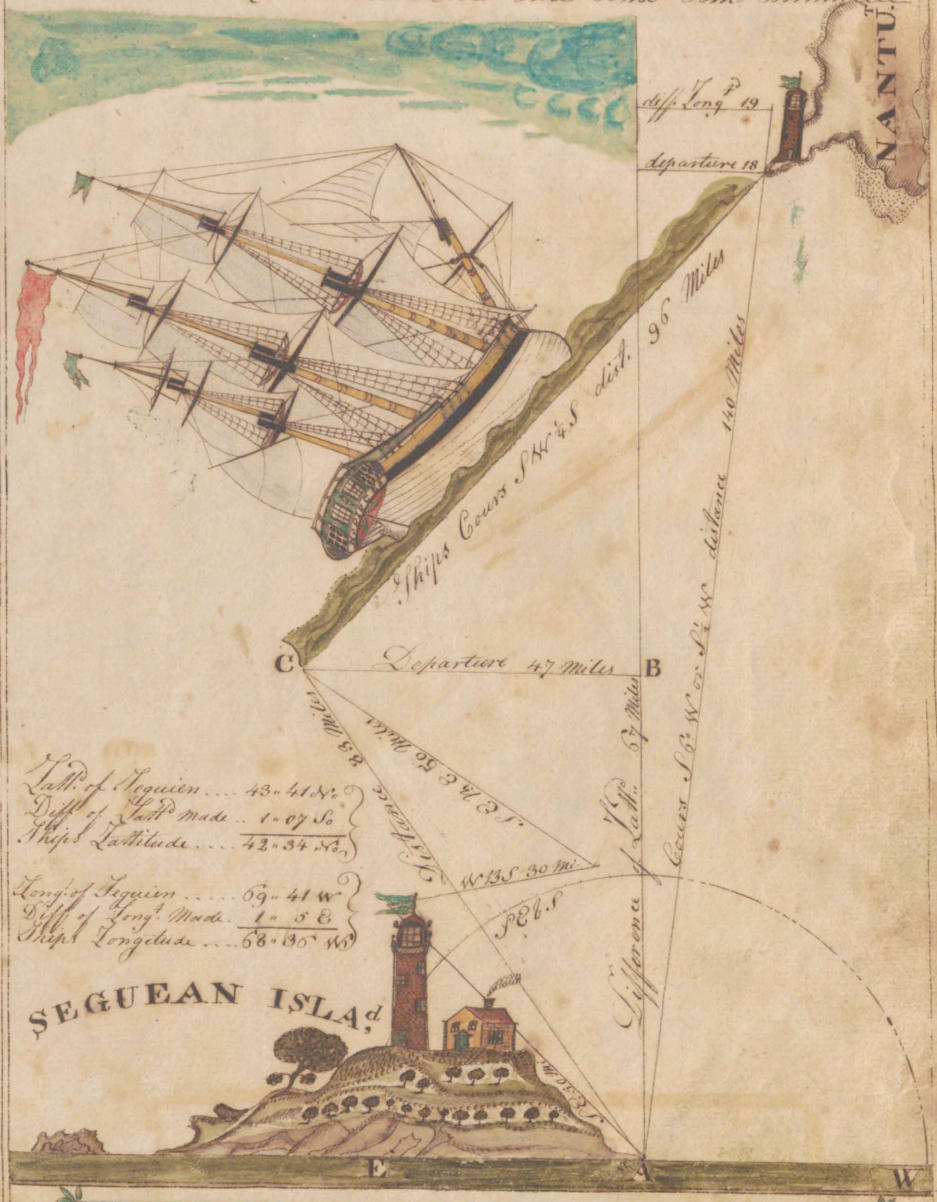


To finds the Course A C			To find the distance		
As the Dif. of Latt.e ..	96	1.98227	As Radious	90	10.00000
So is to Radius	90	10.00000	So to the Dif. Latt.e ...	96	1.98227
So is the departure	120	2.07918	So is the Secan.t of Cour.	51 20	10.20427
To the Tang.t of ye Cour.	51 20	10.09691	To the distance ...	153	2.18554

TRAVERSE SAILING.

EXAMPLE I.

A Ship from the Island of Sequean and bound to Nantucket with a head wind sails the following Courses Viz. S E 50 miles S S W S 30 miles S E b E 60 miles Required her Latt come In too and Longitude In. with the Bearing and distance of Nantucket Lite house


NANTU.
diff. Long.d 19
departure 18
Ships Course S W 1/2 S dist. 96 Miles
distance 140 Miles
C
Departure 47 Miles
B
S E 50 Miles
S W 30 Miles
Latt. of Sequien .... 43° 41' N
Diff.e of Latt. Made .. 1° 07' So.
Ships Lattitude .... 42° 34' 0" N
Long.d of Sequien .... 69° 41' W
Diff.e of Long.d Made .. 1° 5' E
Ships Longitude .... 68° 36' 0" W
SEQUEAN ISLAd
E
A
W

To Find the diff.e of Latt.d			To Find the Dep.t		
As radius	90	10.00000	As radius	90	10.00000
So to the distance	83	1.91908	So to the distance	83	1.91908
So is the Co Sine of Cours	33.45	9.91975	So is the sine Cours	33.45	9.74479
to the diff. of Latt.	69	1.83883	to the departure	45	1.66387

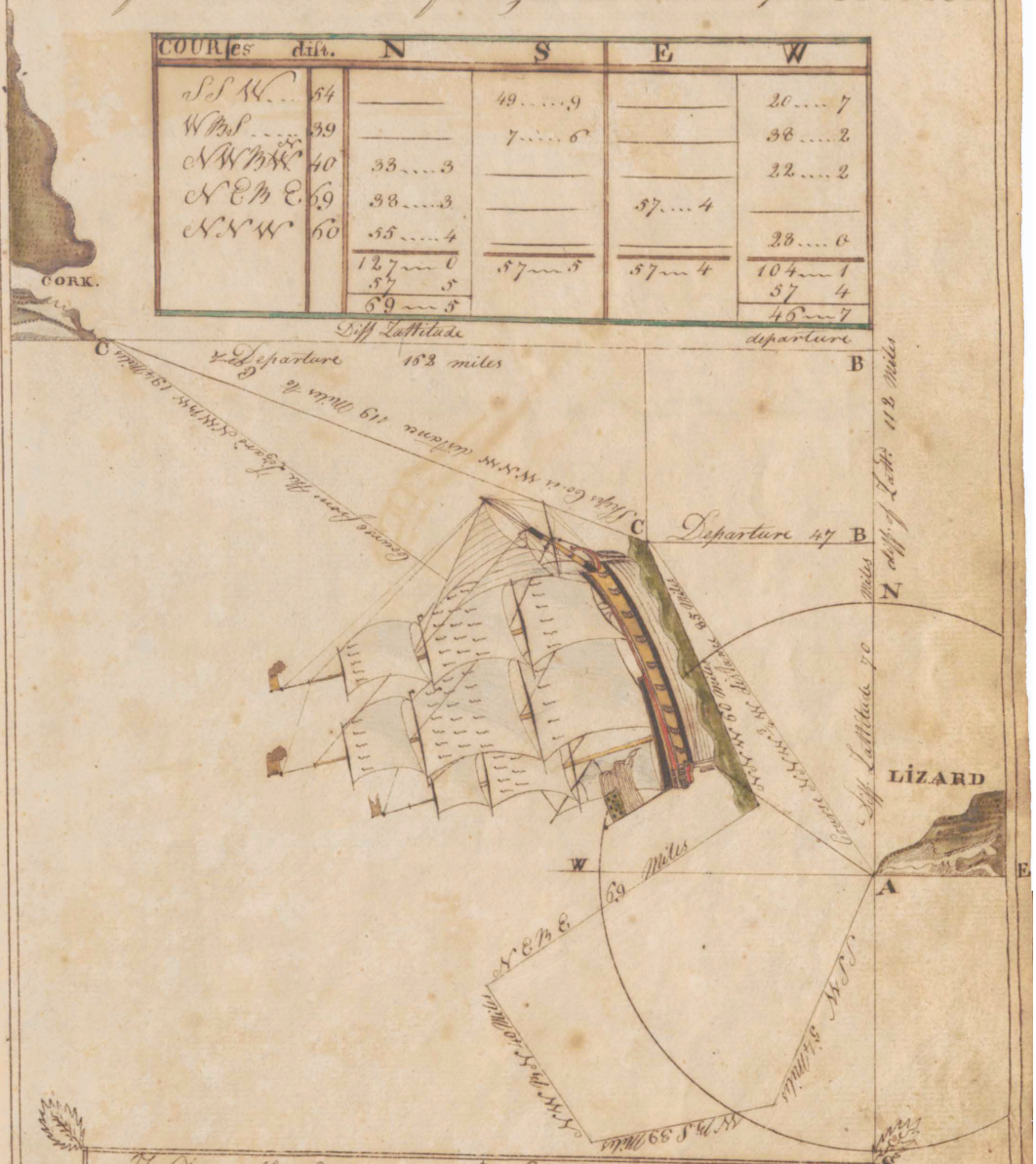
TRAVERSE SAILING,

EXAMPLE II.

Suppose a Ship from the Lizard in Latitude 49°-57 is bound to Cork in Latitude 51° 49 whos departure from the Meridian is 162 West but by Reason Contrary winds is Obliged to Sail on the following Courses Viz. S.S.W 54 Miles W by S 39 miles N.W by N 40 N.E by E 69 Mills N.N.W 60 miles; ~~~~~ I Demand the direct Course distance differance of Latitude and departure made good Upon the Several Courses with the Latt. the Ship is in and what Course she must afterwards steer and how far to gain her intended port ~~~~~~~~

COURSES	dist.	N	S	E	W
S.S.W	54		49....9		20....7
W by S	39		7....6		38....2
N.W by N	40	33....3			22....2
N.E by E	69	38....3		57....4	
N.N.W	60	55....4			23....6
		127—0	57—5	57—4	104—1
		57 5			57 4
		69—5			46—7

Diff Latitude — departure



To Find the Course			To find the Diff. of Lat.		
As the diff. Latt.	112	2.049422	As the sine of the Cours	55.20	9.95[15/2]112
Is to radious	90	10.000000	Is to the departure	162	2.209051
So is the Departure	162	2.209051	So is radious	90	10.000000
To the Tan.t of Course	55.20	10.159029	To the distance	197	2.294339

MIDDLE LATITUDE SAILING.

The following Table shews how many miles answers to a degree of Longitude at every degree of Latitude.

D.L	MILES	D.L	MILES	D.L	MILES	D.L	MILES	D.L	MILES
1	59-99	19	56-73	37	47-92	55	34-41	73	17-54
2	59-96	20	56-38	38	47-28	56	33-55	74	16-33
3	59-92	21	56-01	39	46-62	57	32-68	75	15-32
4	59-86	22	55-63	40	45-95	58	31-79	76	14-31
5	59-77	23	55-23	41	45-28	59	30-90	77	13-30
6	59-67	24	54-81	42	44-59	60	30-00	78	12-48
7	59-56	25	54-38	43	43-88	61	29-09	79	11-45
8	59-42	26	53-93	44	43-15	62	28-17	80	10-42
9	59-26	27	53-56	45	42-43	63	27-24	81	9-38
10	59-08	28	52-97	46	41-68	64	26-30	82	8-35
11	58-89	29	52-47	47	40-92	65	25-36	83	7-32
12	58-68	30	51-96	48	40-15	66	24-41	84	6-28
13	58-46	31	51-43	49	39-36	67	23-45	85	5-23
14	58-22	32	50-88	50	38-57	68	22-48	86	4-18
15	57-95	33	50-32	51	37-75	69	21-50	87	3-14
16	57-67	34	49-74	52	36-94	70	20-52	88	2-09
17	57-37	35	49-15	53	36-11	71	19-54	89	1-05
18	57 06	35	48-54	54	35-26	72	18-55	90	0-00

HENCE IT FOLLOWS

As radius or sine of ..... 90°
Is to the diff. of Longitude in miles
So is the Com. sine of any parall of Lat.
To the dist. in miles between any
Two merid. in that parall of Lat.

AND

As the Com. sine of any parall of Lat.
Is to the dist. run in Miles .....
In that Latitude .....
So is the radius or sine of 90 .....
To the diff. of Longitude in miles .....

PROBLEM I.

The Difference of Longitude between two places beath in one parallel of Latitude being given to find the distance between them

Suppose a Ship In the Lat. of 49-30 N. or S. Sails directly East or West Until her difference of Long. be 3-30. and the distance Sailed be required